Connecting Element

[0001] The invention relates to a connection element for attaching planiform or dish-shaped components to supporting structures, preferably for attaching trim parts to a structure of an aircraft.

[0002] In order to fasten trim parts to a supporting structure of an aircraft, normally a large number of connection elements are used. Such connection elements have to meet a host of boundary conditions that conventional fastening elements, known from prior art, such as screws, clamps and rivets are unable to meet. Without establishing a ranking, such boundary conditions include: sound insulation and thermal insulation; light weight of the connection elements; security against unintended disconnection, even during extreme loads, for example as a result of a fire associated with an accident; easy positioning even in the case of difficult installation conditions; and little expenditure of time and tools for connecting and disconnecting, i.e. for attaching and removing the connection elements.

[0003] It is an object of the present invention to create a connection element as described above, which connection element meets the above-mentioned demands, wherein at the same time the construction expenditure and thus the production costs of such a connection element are kept within reason.

[0004] According to an exemplary embodiment of the invention, a connection is provided having a retainer or holder on the component, on which retainer an insertion trunnion is held so as to be adjustable to a limited extent at least vertically (Z-direction R_z) in relation to the component surface and matches a receiver on the structure, which receiver is made from elastically deformable soft material with a recess for the insertion trunnion, which recess matches the contour of the insertion trunnion in such a way, having positive fit, that said insertion trunnion establishes a snap connection with the receiver, wherein the receiver on the structure comprises a support flange, by means of which support flange said receiver rests flat

against a retainer on the structure, and is adjustably held and attachable in the XY plane that is arranged perpendicular in relation to the direction of connection (R_z).

[0005] With the above connection element, the requirements listed above can be met. The design of the connection as a snap connection may ensure that no special tools are required.

[0006] The adjustability in the Z-direction on the component, and in the XY-direction on the structure makes it possible to compensate for tolerances between the planiform or dish-shaped components to be attached on the one hand, and the supporting structure of an aircraft on the other hand, wherein such compensation or the corresponding adjustment can take place directly when the connection is manually established. The selection of materials ensures that the entire connection element is comparatively light in weight while providing good thermal insulation, thus meeting a central requirement in aircraft engineering.

[0007] In a preferred exemplary embodiment of the connection element according to the invention the insertion trunnion or pin is arranged such that when it snaps into the attachment position of the receiver it activates mechanical or hydraulic devices that firmly clamp the support flange in the retainer on the structure. As a result of this arrangement, the attachment position in the XY-plane, once found, is determined as the final attachment position at the same time as the insertion trunnion snaps into place. Thus, securing the desired position of the retainer on the structure on the one hand, and attaching the insertion trunnion on the component on the other hand, do not occur in steps but instead concurrently.

[0008] In a further exemplary embodiment of the connection element according to the invention of the receiver comprises two recesses for the insertion trunnion, which recesses are spaced apart from each other in the Z-direction. This arrangement may have an advantage in that first the insertion trunnion can be

inserted into the first of the two recesses; in that in this first position positioning of the retainer on the structure can be carried out by installing personnel; and in that the attachment position is attained by precise-fitting final attachment by snap-in into the second recess.

[0009] A further exemplary embodiment of a connection element according to the invention allows the adjustability of the insertion trunnion in the Z-direction being achieved by means of a screw thread. As a result of this, the retaining force acting onto the component to be attached can be adjusted within certain limits. The screw thread should preferably be arranged between the retainer on the component and an anchorage part of the insertion trunnion.

[0010] A further exemplary embodiment, in which the insertion trunnion is held in the anchorage part by means of a ball joint, provides ease of positioning of the retainer on the structure.

[0011] Finally, a further exemplary embodiment should be pointed out. The receiver comprises anchorages on the support flange, through which anchorages a U-shaped securing clamp can be inserted into the body of the receiver, wherein the spacing of the U-limbs matches the diameter of the base of the insertion trunnion such that it is not possible to pull the insertion trunnion out while the securing clamp is in place. Such arrangement of the connection element ensures the fail-safe behaviour of the connection element in that, even if the body of the receiver on the structure has been destroyed by excessive forces or excessive temperature, e.g. as a result of a fire, the connection between the component and the structure cannot become fully undone. In the case of an aircraft this is of great importance because danger to the passengers must be avoided under any circumstances, for example danger in the passenger compartment as a result of parts that come undone due to unforeseen damage to the connection element or elements.

[0012] With reference to the accompanying drawings, the invention is explained by means of examples.

[0013] The drawings show the following:

[0014] Fig. 1 shows a diagrammatic view of a section of a connection, established with a connection element according to the invention, between a trim part and the structure of an aircraft;

[0015] Fig. 2 shows a diagrammatic view of the introduction of the clamping force for firmly clamping the retainer to the structure;

[0016] Fig. 3 shows a simplified partial view according to line III-III in Fig. 1;

[0017] Fig. 4 shows an oblique diagram of the receiver on the structure, with an insertion trunnion snapped into position 1;

[0018] Fig. 5 shows a partial section of the receiver on the structure, in the closed position according to Fig. 1; and

[0019] Fig. 6 shows the sequence of attaching a trim part to the structure of an aircraft by means of a connection element corresponding to Figs 1 to 4 with positions 1 and 2.

[0020] The diagrammatic section view according to Fig. 1 shows the attachment of a trim part 2 to the structure 1 of an aircraft. Attachment takes place by means of a connection element which on the component comprises a retainer 4 in the form of a cylindrical sleeve, which in turn is attached to the surface 21 of the component 2. The inside of the retainer 4 on the component comprises a thread 41,

into which thread an anchorage part 42 has been screwed. In a ball socket 44 of the anchorage part 42 the spherical head of an insertion trunnion 6 is held and secured by means of a trunnion retainer 43. The insertion trunnion or pin 6 can thus be swivelled, to a limited extent, in the ball joint created. By screwing the thread 41 in or out, the position of the insertion trunnion 6 in Z-direction can be adjusted. The lower end of the insertion trunnion 6 thus forms a base 66 that slopes on both ends and that has an increased diameter. In the position as shown in Fig. 1, this base 66 is held (position 2), having positive fit, in the lower of two identically designed recesses 53 of a cylindrical body 56, which component 5 in its entirety is designated the receiver on the structure.

[0021] On the cylindrical body 56 of the component 5, a support flange 51 adjoins downwards, which support flange 51 adjoins over an area in a flat recess 31 of a retainer 3 on the structure and is secured to the retainer 3 on the structure by means of a retaining plate 32. The depth of the flat recess 31 is slightly larger than the depth of the support flange 51. In position 1 as shown in Fig. 1 the receiver 5 on the structure has been firmly clamped over the support flange 51 in the retainer 3 on the structure, which takes place in that a pin 65 at the bottom end of the insertion trunnion 6 (compare Fig. 5), according to the shown line of application of a force K, by way of an intermediate pin 55 of the receiver 5, activates a mechanical or hydraulic device 35 which in turn, along the path of application 36, exerts a clamping force on the support flange 51 against the retaining plate 32.

[0022] Fig. 2 diagrammatically shows the introduction of the clamping force for clamping the receiver 5 on the structure in the retainer 3 on the structure. Identical components have the same reference characters as in Fig. 1. Transmission of the force K for introducing a clamping force between the support flange 51 and the holder 3 on the structure preferably takes place by mechanical levers or push rods, but it could also take place hydraulically.

[0023] The simplified partial view, shown in Fig. 3, corresponding to the line II-II in Fig. 1 shows how the insertion trunnion 6 is secured in the receiver 5 on the structure by means of a U-shaped securing clamp 54. To this effect anchorages 52 are provided on the support flange 51, which anchorages 52 comprise flush boreholes through which the two U-limbs of the securing clamp 54 can be placed. Preferably the diameter of the boreholes matches the limbs of the securing clamp 54 such that a clamping seat is achieved. However, it is also possible for the securing clamp 54 on the two ends of the U-limbs to also be secured against sliding from the anchorages 52. The spacing A between the U-limbs matches the diameter D of the base 66 of the insertion trunnion 6 such that it is not possible to pull the insertion trunnion out when the securing clamp is in place. Thus, even if the cylindrical body 56 of the receiver 5 on the structure were to be destroyed, either as a result of mechanical failure or as a result of a fire, the insertion trunnion 6 would be firmly held to the structure by the securing clamp 54. The securing clamp 54 and the anchorages 52 are preferably made from a metallic material, while the remaining components of the connection element are preferably made from a plastic material, wherein elastomers are particularly well suited. Instead of providing a U-shaped securing clamp 54, the provision of individual securing pins is also possible.

[0024] The oblique diagram, shown in Fig. 4, of the receiver 5 on the structure, with the insertion trunnion 6 snapped-in in position 1, as well as the partial section of the receiver 5 on the structure, shown in Fig. 5, both show the pin 65 acting on the base 66 of the insertion trunnion 6 on the corresponding pin 55 to generate a clamping force K. In the oblique diagram according to Fig. 4 the insertion trunnion 6 is in position 1, i.e. in a position in which the support flange 51 in the flat recess 31 of the retainer 3 on the structure is still slidable in the XY-plane. Consequently, prior to attachment, the receiver 5 on the structure can adapt to a desired position of the component 2 to be attached. Finally, the oblique diagram according to Fig. 4 shows boreholes 57, 58 for accommodating the limbs of the securing clamp 54.

[0025] The advantage of precise-fitting installation and attachment of planiform or dish-shaped components by means of the connection elements described is described with reference to the sequence, shown in Fig. 6, for attachment with position 1 and position 2: position 1 is the position in which the insertion point 6 is snapped in, as shown in Fig. 4, in the upper recess 53 of the receiver 5 on the structure.

[0026] In this position the connection element can be displaced in the XY-plane to a limited extent in relation to the retainer 3 on the structure. In this arrangement an indicator that has been provided, which can be designed to operate mechanically, electrically or electronically, indicates to the installing personnel the necessary displacement of the component 2 to reach a position which in the second position, i.e. in the attachment position of the connecting element, ensures an absolutely precise-fitting connection to already existing construction elements. In the same way the indicator serves to indicate the spacing of the component 2 in the Z-direction from its final position. If this spacing differs from a specified value to achieve the desired final height in Z-direction in position 2, which is the attachment position, on the retainer on the component, or on the anchorage part, the correct height can be set by changing the spacing (screw thread 41) so that after snapping into position 2 the component 2 has attained the desired precise final position.

List of reference characters

1	Structure
2	Trim part (component)
21	Component surface
3	Retainer on the structure
31	Flat recess
32	Retaining plate
35	Mechanical or hydraulic devices
4	Retainer on the component
41	Thread
42	Anchorage part
43	Trunnion retainer
44	Ball socket
5	Receiver on the structure
51	Support flange
52	Anchorages
53	Recesses in 5
54	U-shaped securing clamp
55	Intermediate pin
56	Cylindrical body
57	Boreholes in 56
58	Boreholes
6	Insertion trunnion
65	Pin
66	Base
R_z	Direction of connection